

Metodo Bell- Delaware

DATOS PARA ANALISIS DE COEFICIENTE GLOBAL

DIMENSIONES DEL INTERCAMBIADOR ANALIZADO

Tubos

$N_t = 9$ Número de tubos del intercambiador

$d_i = 0.01655$ Diámetro interno de tubo

$d_o = 0.01905$ Diámetro externo de tubo

$L_t = 3.54$ Longitud de tubo

$L_{bc} = 0.21$ Distancia de baffle central

$L_{bb} = 0.01$ distancia entre dotl y los tubos

$D_{OTL} = 0.13$ [m] Diametro exterior de haz de tubos

$$L_{tp} = \frac{15}{16} \cdot 0.0254$$

$$D_{ctl} = D_{OTL} - d_o$$

$$S_m = L_{bc} \cdot \left[L_{bb} + \frac{D_{ctl}}{L_{tp}} \cdot (L_{tp} - d_o) \right] \text{ Area de flujo cruzado}$$

FLUIDO EN LOS TUBOS -AGUA DE ENFRIAMIENTO-

$R\$ = \text{'Water'}$ string variable used to hold name of refrigerant

$t_1 = 16.6$

$t_2 = 21.6$

$P_p = 101.325$

$$T_p = \frac{t_1 + t_2}{2} \text{ Temperatura de película fluido tubos}$$

Propiedades del fluido frio

$$k_1 = \mathbf{k} [R\$, T= T_p, P= P_p]$$

$$\rho_1 = \rho [R\$, T= T_p, P= P_p]$$

$$\mu_1 = \mathbf{Visc} [R\$, T= T_p, P= P_p]$$

$$Pr_1 = \mathbf{Pr} [R\$, T= T_p, P= P_p]$$

$$cp_1 = \mathbf{Cp} [R\$, T= T_p, P= P_p]$$

$$h_1 = \mathbf{h} [R\$, T= T_p, P= P_p]$$

$$s_1 = \mathbf{s} [R\$, h = h_1 , P = P_p]$$

$$\rho_2 = \rho [R\$, T = t_2 , P = P_p]$$

Lectura de rotámetro lado tubo

$$V_{\text{rotámetro}} = 5 \text{ [GPM]}$$

$$\dot{V} = V_{\text{rotámetro}} \cdot \frac{3.785}{60 \cdot 1000}$$

$$\dot{m} = \dot{V} \cdot \rho_2 \text{ Flujo total}$$

$$\dot{m}_t = \frac{\dot{m}}{N_t} \text{ Flujo por cada tubo}$$

$$A_i = \pi \cdot \left[\frac{d_i}{2} \right]^2 \text{ Area transversal tubo}$$

$$G_t = \frac{\dot{m}_t}{A_i} \text{ Masa velocidad de tubo}$$

$$Re_t = \frac{d_i \cdot G_t}{\mu_1} \text{ Reynolds de tubo}$$

Temperaturas de agua solar caliente

$$T_1 = 30$$

$$T_2 = 24$$

$$T_p = \frac{T_1 + T_2}{2}$$

Propiedades del fluido caliente

$$h_2 = \mathbf{h} [R\$, T = T_p , P = P_p]$$

$$s_2 = \mathbf{s} [R\$, h = h_1 , P = P_p]$$

$$k_2 = \mathbf{k} [R\$, T = T_p , P = P_p]$$

$$\rho_3 = \rho [R\$, T = T_p , P = P_p]$$

$$\mu_2 = \mathbf{Visc} [R\$, T = T_p , P = P_p]$$

$$Pr_2 = \mathbf{Pr} [R\$, T = T_p , P = P_p]$$

$$cp_2 = \mathbf{Cp} [R\$, T = T_p , P = P_p]$$

Lectura del rotámetro lado coraza

$$V_{\text{rot}} = 5 \text{ [GPM]}$$

$$\dot{V}_2 = V_{\text{rot}} \cdot \frac{3.785}{60 \cdot 1000}$$

$$\rho_4 = \rho [R\$, T=34, P=Pp]$$

$$\dot{m}_2 = \dot{V}_2 \cdot \rho_4 \quad \text{Flujo total}$$

$$G_c = \frac{\dot{m}_2}{S_m} \quad \text{Masa velocidad de la coraza}$$

$$Re_c = \frac{d_o \cdot G_c}{\mu_2} \quad \text{Reynolds de coraza}$$

Calculo de factor de fricción con la ecuación de Konakov

$$f = [1.8 \cdot \log(Re_t) - 1.5]^{-2}$$

Calculo de Nusselt a través de f y Re_t

$$N.u_t = \left(\frac{f}{8} \right) (Re_t - 1000) Pr_1 / \left(1 + 12.7 \left(\frac{f}{8} \right)^{1/2} \left(Pr_1^{2/3} - 1 \right) \right) \left(1 + \frac{d_i}{L_t} \right)^{2/3}$$

$$N.u_t = 0.023 \cdot Re_t^{0.8} \cdot Pr_1^{0.4}$$

Calculo de coeficiente de convección interior -tubos-

$$h_i = N.u_t \cdot \frac{k_1}{d_i}$$

$$h_{io} = h_i \cdot \frac{d_i}{d_o} \quad \text{corrección por area}$$

Calculo de coeficiente global de tubos ideal h_{oi}

$$J_i = 0.02713 + 1.492e-5 \cdot (Re_c - 600)$$

Factor de corrección J_i

$$J_i = 0.0233 - 0.000005201 \cdot [Re_c - 1000]$$

$$h_{ci} = h_{oc}$$

$$h_{oc} = cp_2 \cdot G_c \cdot J_i \cdot Pr_2 \left[\frac{-2}{3} \right] \cdot 1000 \cdot 0.6$$

$$\frac{1}{U_{teórico}} = \frac{1}{h_{io}} + \frac{1}{h_{oc}}$$

$$R_f = 0.0001$$

$$\dot{Q} = \dot{m} \cdot cp_1 \cdot [t_2 - t_1] \cdot 1000$$

$$A_{TC} = \pi \cdot d_o \cdot L_t \cdot N_t$$

$$DT_1 = T_2 - t_1$$

$$DT_2 = T_1 - t_2$$

$$DT_{ml} = \frac{DT_1 - DT_2}{\ln \left[\frac{DT_1}{DT_2} \right]}$$

$$\dot{Q} = U_{\text{experimental}} \cdot A_{TC} \cdot DT_{ml} \cdot F_C$$

$$R = \frac{T1 - T2}{t_2 - t_1}$$

$$P = \frac{t_2 - t_1}{T2 - t_1}$$

$$F_C = 1$$

Unit Settings: [kJ]/[C]/[kPa]/[kg]/[degrees]

Ai = 0.0002151

di = 0.01655

DT₂ = 8.4

f = 0.04615

G_t = 162.569

hio = 851.4

Lt = 3.54

L_{bc} = 0.21m_t = 0.03497

P = 0.6757

R = 1.2

Re_t = 2625.980

T1 = 30

t₁ = 16.6U_{experimental} = 437.6V₂ = 0.0003154A_{TC} = 1.907

do = 0.01905

DT_{ml} = 7.889F_C = 1

hci = 818.9

ho_c = 818.9L_{tp} = 0.02381

m = 0.314750 [kg/s]

N.u_t = 27.75

Pp = 101.3

R\$ = 'Water'

R_f = 0.0001

T2 = 24

t₂ = 21.6U_{teórico} = 417.4V_{rot} = 5 [GPM]

Dctl = 0.111

DT₁ = 7.4D_{OTL} = 0.13 [m]G_c = 46.4

hi = 980.013

Ji = 0.0231

L_{bb} = 0.01m₂ = 0.313642

Nt = 9

Q = 6583

Re_c = 1038S_m = 0.0067599

Tp = 19.1

T_p = 27

V = 3.154E-04

V_{rotámetro} = 5 [GPM]Arrays Table

	cp _i	h _i	k _i	μ _i	Pr _i	ρ _i	s _i
	[kJ/kg-K]	[kJ/kg]	[W/m-K]	[kg/m-s]		[kg/m ³]	[kJ/kg-K]
1	4.183	80.16	0.5845	0.001025	7.333	998.4	0.2833
2	4.183	113.2	0.5981	0.0008514	5.955	997.9	0.2833
3						996.5	
4						994.4	